

GENERAL NOTES

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THE STRIDULATORY ORGAN IN *HAMADRYAS* (NYMPHALIDAE): PRELIMINARY OBSERVATIONS

Additional key words: Wing morphology, sound production, discal cell, *Hamadryas feronia*, *Hamadryas februa*.

Sound production in *Hamadryas* has long been a subject of speculation regarding the location and functional mechanism of the stridulatory organ. Several possible explanations have been proposed, such as noise being produced by a membranous sac in the base of the forewing (E. Doubleday, in Darwin, C. 1871, *The descent of man and selection in relation to sex*, Vol. I, John Murray, London, vii + 423 pp.), by a stridulatory comb (Swinton, A. H., 1877, *Entomol. Month. Mag.* 13:207-208), by coupling and sudden release of chitinized structures in the bases of wings (Hampson, G. F., 1892, *Proc. Zool. Soc. London* XIV:188-193; Jenkins, D. W., 1983, *Bull. Allyn Mus.*, No. 81, 146 pp.), scutum movements during flight (Swihart, S. L., 1967, *J. Insect Physiol.* 13:469-476), and by friction of two lateral distad-extending projections of the eighth abdominal sternum of males (J. L. Reverdin, in Fruhstorfer, H., 1916, *Ageronia*, pp. 537-545, in Seitz, A. (ed.), *Macrolepidoptera of the world*, Vol. 5, The American Rhopalocera, Alfred Kernen, Stuttgart, viii + 1139 pp.; Scott, J. A., 1986, *The butterflies of North America*, Stanford Univ. Press, Stanford, California, xiii + 583 pp.). A common feature of all these propositions is the lack of any experimental evidence other than observation of butterflies in free flight or morphological studies of dissected specimens.

Contrary to what has been accepted in the past (e.g., Swihart *op. cit.*), it is possible to have *Hamadryas* stridulate while being hand-held, by the following manipulations: switching their hindwings from their normal position to an upper position with respect to forewings, holding the hindwings with tweezers in the sagittal plane, and stimulating the movement of the free forewings, which in this position can move through their complete wing-beat cycle (Fig. 1). By manipulating hand-held individuals of *H. feronia* in this way and observing wing morphology, I obtained some preliminary data about the topographic location and functional mechanism of the stridulatory organ.

In *H. feronia*, only the male produces the loud sounds so characteristic of this and other species of the genus. If the forewings of male and female *H. feronia* are compared,

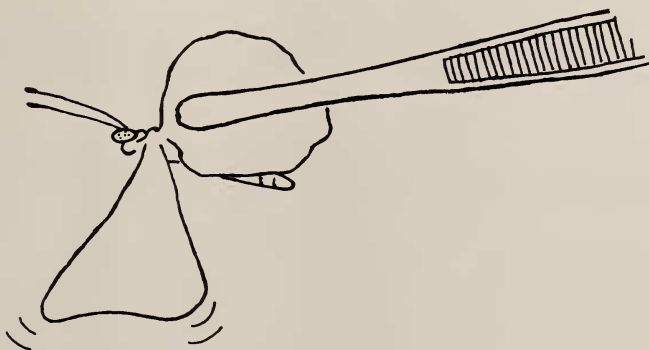


FIG. 1. Manipulation of individual *H. feronia* butterflies to allow free movement of the forewings.

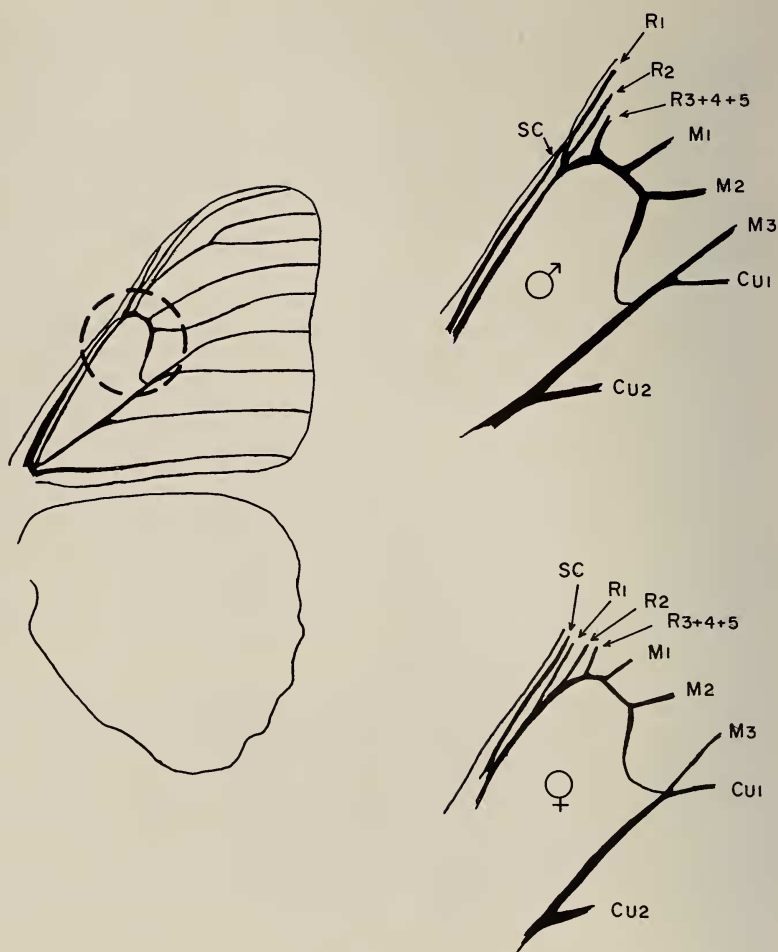


FIG. 2. Venation differences in forewings of male and female *H. feronia*. Vein nomenclature conforms to the Comstock and Needham system (Miller, L.D., 1969, J. Res. Lepid. 8:37-48).

obvious differences in venation can be observed (Fig. 2). These differences, and the fact that the sound is produced during the superior half of the upstroke of the wing beat, led me to perform a series of ablation experiments on male forewings. Ablations were made with a razor blade while the butterfly's wing to be operated on was held against a flat surface. The results of these treatments may be summarized as follows:

1. When the apical portions of both wings were removed by cutting beyond the discal cell (Fig. 3a'), the butterfly was still able to stridulate, but when the cut was made below the apex of the discal cell (Fig. 3a''), the butterfly was unable to stridulate.
2. Removal of the thickened transverse wing veins in the apex of the discal cell, including the proximal portion of M_2 - M_3 (Fig. 3b, $n = 5$), or removal of only the portion between the insertion of R_{3+4+5} and M_2 (Fig. 3c, $n = 4$), suppressed stridulation

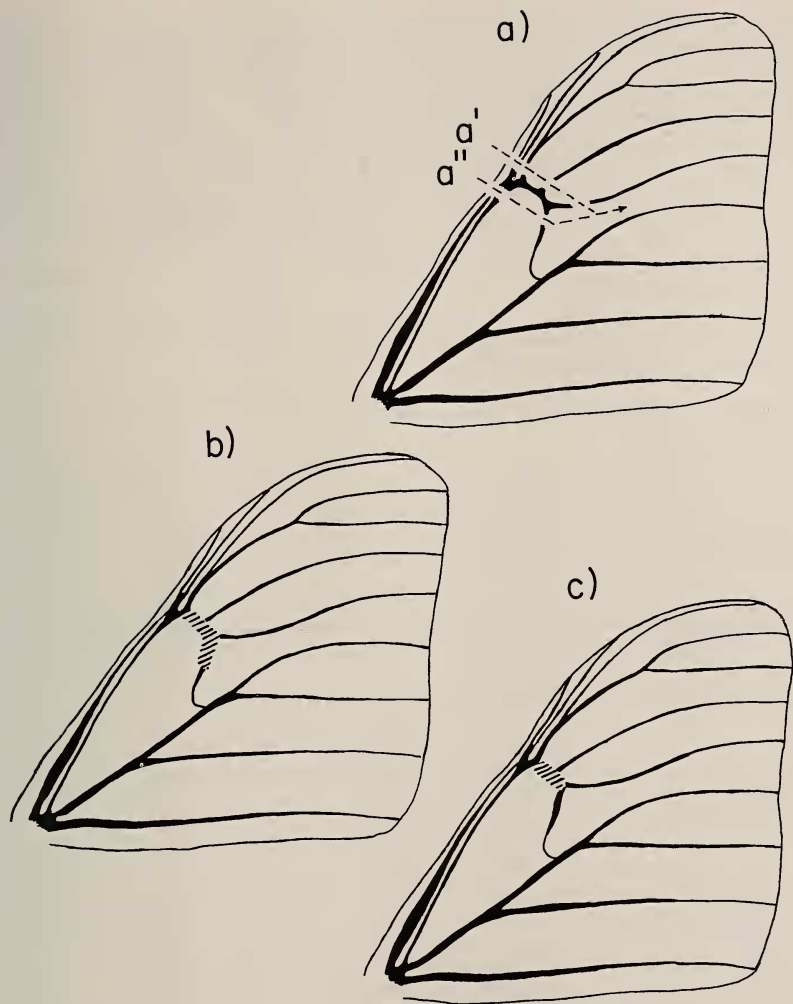


FIG. 3. Ablation experiments on the forewing of male *H. feronia* (see text for explanation).

when the cut was made on both wings. Curiously, when such cuts were made on only one of the wings, stridulatory ability persisted, but when the apical part of one of the wings was removed by cutting below the apex of the discal cell, the stridulatory ability was cancelled even if the other wing remained intact.

These results suggest that the stridulatory mechanism is associated with the thickened veins that close the discal cell at its apex. Even though these observations do not elucidate the functional mechanism, the strike of both wings at the end of the upstroke, with the sudden deformation of chitinized structures at the apex of the discal cell, seems to be the probable cause of sound production.

The male wing-vein characteristics referred to above seem to be a common feature in all species that have been reported as stridulators, except *H. februa*, which exhibits a

venation similar to that of female *H. feronia* in both sexes. Even though *H. februa* is commonly cited as a stridulating species, behavioral studies revealed that males of this species in northern Venezuela populations do not produce the characteristic loud clicking sounds of several species of the genus (Otero, L. D. 1988, Contribución a la historia natural del genero *Hamadryas* (Lepidoptera: Nymphalidae), Tesis doctoral, Universidad Central de Venezuela, Facultad de Agronomía, Instituto de Zoología Agrícola, Maracay, viii + 108 pp.). This leaves open the question of whether this absence of stridulation is a particular feature of Venezuelan populations or if previous reports of stridulation in *H. februa* are due to field misidentifications, a likely possibility considering the similarity of *H. februa* with other species when seen from a distance.

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DIFFERENCES BETWEEN NEARCTIC PAMMENE PERSTRUCTANA AND ITS MOST SIMILAR PALEARCTIC RELATIVES (TORTRICIDAE)

Additional key words: Olethreutinae, Grapholitini, taxonomy.

Pammene is distinguished from other genera of Grapholitini, subfamily Olethreutinae, by the presence in males of dorsal hair tufts beneath scales on tergites 6, 6 and 7, or 6-8 (illustrated in the following two sources: Kuznetsov, V.I., 1987, Family Tortricidae . . . , pp. 279-967, in Medvedev, G.S., [ed.], Keys to the insects of the European part of the USSR, vol. 4, pt. 1, Tech. Transl. 81-52013, U.S. Dept. Comm.; Miller, W. E., 1987, U.S. Dept. Agr., Agr. Handb. 660, 104 pp.). In the Nearctic, *Pammene* is also distinguished from other genera by veins Sc and Rs in the male being united beyond the discal cell (illustrated by Heinrich, C., 1926, U.S. Natl. Mus. Bull. 132, 216 pp.). The known *Pammene* larvae feed in fruits, catkins, and beneath bark of woody plants (Danilevsky, A. S., & V. I. Kuznetsov, 1968, Fauna USSR, Lepidopterous insects, vol. 5, pt. 1, U.S.S.R. Academy of Sciences, Leningrad, 635 pp. [Russian]).

The *Pammene obscurana* (Stephens) species group, long a problem taxonomically in the Palearctic because of indistinct species limits, was resolved into four species by V. I. Kuznetsov (1961, Entomol. Rev. [Entomol. Obozr. in English transl.] 40:506-513). This group is represented in the Nearctic only by *P. perstructana* (Walker), which I identified after it had eluded proper generic placement for more than a century (Miller, W. E., 1985, Great Lakes Entomol. 18:145-147). In reporting this belated identification, I noted a strong resemblance between *P. perstructana* and Palearctic *P. clanculana* (Tengstrom).

Here I compare *P. perstructana* with *P. clanculana* and *P. obscurana*, its most similar Palearctic relatives. I measured dimensions with an ocular micrometer at magnifications of 10 to 45 \times , and counted vesical cornuti at 200 \times . The main findings are shown in Table 1.

One structural difference among the three taxa involves cornuti: *P. perstructana* and *clanculana* have only developed ones, the latter the fewest; whereas *P. obscurana* has both developed and rudimentary ones (Table 1).

Another structural difference involves valval length. Valval length and forewing length appear independent of one another in the three taxa (Table 1). Valvae are shortest in *P.*